CONCURRENT ENGINEERING AND SYSTEMS INTEGRATION AT A VIRTUAL ENTERPRISE

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Abstract

Concurrent engineering is a relatively recent term which is applied to the engineering design philosophy of cross-functional cooperation in order to create products which are better, cheaper and more quickly brought to market. Integrated systems analysis can be defined as an application of the scientific method for examination of complex problems impacted by interdisciplinary component systems. Therefore, is a combination of theories and techniques for studying and describing different methods [1].

This paper will explain the relationship between Concurrent Engineering and Systems integration and how both can be applied to a Virtual Enterprise. Always focusing on satisfying the customer.

Another goal is to give the reader a wider understanding of the importance of concurrent engineering along with systems integration and its use.

Concurrent engineering has become an important paradigm in product development and a widely accepted concept. However, concurrent engineering domain has very many different facets and large amounts of information are available and this paper is a selection of important information that students, employees and owners in the manufacturing field should know.

I. INTRODUCTION

This paper is intended for individuals in manufacturing and the shop floor who want to learn how concurrent engineering relate to systems integration in a virtual enterprise. It will help any organization to have a more clear direction in which to rally the problem-solving teams. It is also created for people who want to remain leaders, shop owners or other manufacturing professional.

The focus of this paper is to integrate the concept of concurrent engineering along with systems integration process into a virtual enterprise in order to be successful among competitors. The significance of the paper is to give manufacturers the opportunity to understand better the process of concurrent engineering with systems integration in a virtual enterprise, now that e-business is becoming popular and successful.

II. LITERATURE REVIEW

Traditionally engineering had a relatively short time spent defining a product. A relatively long time spent designing the product and surprisingly a long time is often spent redesigning the product. In the past the development process of a product was to plan, do, check, act and finally adjust. While today we use concurrent engineering. "Concurrent engineering is a process in which appropriate disciplines are committed to work interactively to conceive, approve, develop, and implement product programs that meet pre-determined objectives." [2].

The implementation of concurrent engineering addresses three main areas: people, process, and technology. It involves major organizational changes because it requires the integration of people, business methods, and technology and is dependent on cross-functional working with teamwork. A good example is the Boeing's Ballistic Systems Division where Concurrent Engineering was used in 1988 to develop a mobile launcher for the MX missile and was able to reduce design time by 40% and cost by 10% in building a prototype [3].

System integration is the successful putting together of the various components, assemblies, and subsystems of a system and having them work together to perform what the system was intended to do [4].

In implementing concurrent engineering there must be a convenient platform on which different divisions for a new product development can work and communicate simultaneously. For mechanical engineering, this platform should be advanced CAD/CAM/CAE software, which has solid and parametric modeling capabilities. An example of

software with these characteristics is SDRC's I-DEAS.

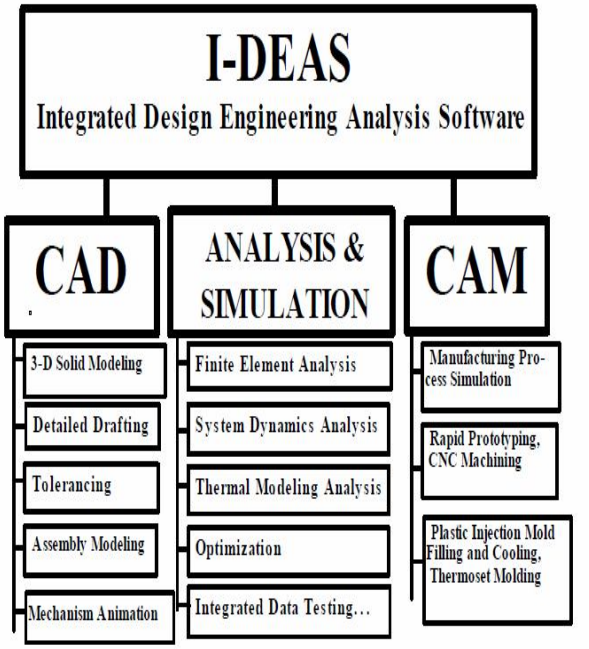

Fig. 1. Example of CAD/CAM/CAE software

Fig. 1.0 shows typical CAD/CAM/CAE software for Concurrent Engineering applications [2]. This software example can be simultaneously used by different teams for design, analysis, simulation, testing, manufacturing, quality control and marketing the virtual enterprise.

The concept of a virtual enterprise was developed and introduced in the 1980's. Youngsun Kwon, Hong-Kyu Lee, Sunmi Lee, and Jungsub Lee define the "pure" virtual enterprise as an enterprise that does not own traditional production factors, based on the observation that these are the source of rigidity in the management of the real enterprise [5].

III. CONTENT

Concurrent engineering has grown to a major industrial discipline enabling highly specialized and effective small and medium-sized enterprises to supply product/services to major industrial companies. The identification and development of architectures, tools, standards and organizational processes linked with integration of networked and information technology supported activities in the virtual enterprise are the key challenges into the integration [6].

Flexibility, responsiveness, scalability, maintainability, ease of use, integration and performance are examples of desirable life-cycle characteristics. Diverse methods are needed to engineer systems that exhibit desirable life-cycle characteristics and for engaging teams of people in critical life-cycle system development activities [7].

Important considerations when implementing concurrent engineering and systems integration are that component developers and system integrators must understand the key properties of the integration technologies they are applying to the virtual enterprise. Considerations to be aware of while being part of the team are:

a. Communication.

b. Easy exchange of information between software packages among the same domain.

c. The architecture used needs interoperability with a non-intrusive manner.

d. The architecture should use a publicly accessible meta-data developed and managed by the parties involved.

e. Data is an asset and the virtual enterprise needs quality data measured at all times.

f. Each island of information or data warehouse should have a responsible party in order to avoid incorrect or lost data.

g. Fast and simple accessibility to the data by users.

It is important to know that integration tools are becoming as essential as the design tools. Representation and evaluation of the service-level is a crucial aspect of integration. Automation to key portions of the integration process are critical and standard-based inter-operability of design-time tools is also a key to realizing the benefits of integration [8].

When serving multiple large vendors, manufacturers have to follow and support different communication technology environments as well as diverse executions of concurrent engineering business processes that make whole project a more complicated, which could increase cost. A possible solution is creating a service-oriented architecture supported by an XML model. Some of the challenges when implementing a service-oriented architecture are:

– the lack of interoperability between different systems;

– the underlying information and communication technology infrastructure;

– the procedures used within the virtual enterprise of the manufacturing community.

Fig. 2.0 shows the main goal of the systems architecture, which is to enable and promote the boundary less flow of manufacturing information within the virtual enterprise. It explains the general process of concurrent engineering, information and communication technology at a Virtual Enterprise [6].

In general this architecture for virtual enterprises in manufacturing will give the business 100% fulfillment of customer requirements, faster design, reduced time to prototype, faster decision-making and reduction of waste. It will also support all phases of the manufacturing concurrent engineering process while keeping the considerations such as: exchange of information between software packages.

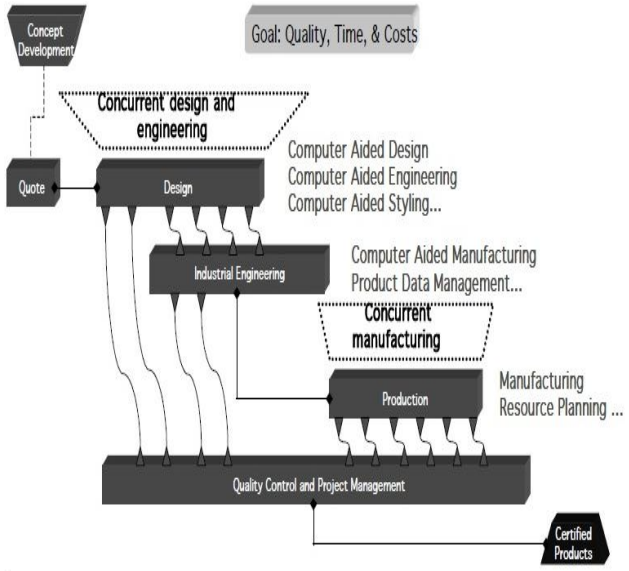

Fig. 2.0. General process of concurrent engineering [6]

IV. SUMMARY AND CONCLUSIONS

In today's business world, corporations must be able to react to changing market needs rapidly, effectively, and responsively. They must be able to reduce their time to market and adapt to changing environments. Decisions must be made quickly and correctly the first time. Corporations can no longer waste time repeating tasks, thereby prolonging the time it takes to bring new products to market. Therefore, concurrent engineering and system integration have emerged as a way of bringing rapid solutions to the product design and development process.

This paper is just the beginning of an out-going research that needs to be done in order to understand the importance of concurrent engineering and systems integration to the virtual enterprise.

V. FUTURE RESEARCH

The virtual enterprise is no longer a new term and is important to review and analyze its future. It will also be important to measure the benefits, effectiveness and advantages, if any, when implementing concurrent engineering and systems integration into a virtual enterprise.

REFERENCES

[1] Soroczynski, Integrated Systems Analysis and Sustainable Development. Retrieved from http://www.iemss.org/iemss2002/proceedings/pdf/volume%20tre/97_soroczynski.pdf

[2] Zayas, J; Barton, R; Nowack, C. and Smith, R. (2008), Introduction to Concurrent Engineering, Concurrent Engineering Course Materials, Module 1.

[3] Stark, J. (2009), A few words about concurrent engineering, John Stark Associates, http://www.johnstark.com/default.html

[4] Condensed GSAM Handbook (2003) Systems Integration. Chapter 14, 14-3. Retrieved from: http://www.stsc.hill.af.mil/resources/tech_docs/gsam4/chap14.pdf

[5] Kwon, K; Lee, H; Lee S, and Lee, J. (2003) The Virtual Enterprise: Redefining the Concept, School of Management, Information and Communications University, Taejon, 305-732, South Korea. Retrieved from: http://www.springerlink.com/content/1cyntcydhnxd3nr8/fulltext.pdf?page=1

[6] Sundmaeker, Hansen, Serraspereira, Gold and Lamasdeoliviera. *Integration of Concurrent Engineering Business Processes via Service Oriented Architectures in the Virtual Enterprise*. Retrieved October 25, 2009 from http://subs.emis.de/LNI/Proceedings/Proceedings56/GI-Proceedings.56-16.pdf

[7] Mayer, Crump, Fernandes, Keen and Painter. (1995). *Information Integration for Concurrent Engineering (IICE) Compendium of Methods Report.* Retrieved from http://www.idef.com/pdf/compendium.pdf

[8] Balasubramanian, K; Schmidt, D; Molnar, Z. and Ledeczi, A. System Integration using Model-Driven Engineering, Institute for Software Integrated Systems, Vanderbilt University, Nashville, Retrieved from: http://www.dre.vanderbilt.edu/~kitty/pubs/bookchapter-final.pdf

[9] Zhou, J; Carmi, S; Lau, A & Douglas, S. (1996), Concurrent Engineering Concepts Applied to Concurrent Education and Research, (Unpublished article), *ISPE International Conference on Concurrent Engineering Research and Applications*, Department of Mechanical Engineering and Mechanics, Drexel University, Philadelphia, PA, Retrieved from: http://www.mem.drexel.edu/zhou/PDF-files/CEforClass.PDF